

# Natural Gas Composition in California

---

What is in the gas that is leaking from California stoves?





## **Eric Lebel, PhD, *Senior Scientist***

Dr. Lebel is senior scientist at PSE Healthy Energy. As a graduate student at Stanford University, he measured methane emissions from natural gas water heaters and stoves.



## **Drew Michanowicz, DrPH, MPH, CPH, *Senior Scientist***

Dr. Michanowicz is a senior scientist at PSE Healthy Energy. His research focuses on the poorly communicated human health and safety costs of our present and future energy choices.



## **Kelsey Bilsback, PhD, *Senior Scientist***

Dr. Bilsback is senior scientist at PSE Healthy Energy. Her work uses modeling to evaluate the impacts of energy production and use on air quality and human health.

*Gas stoves create air pollution  
when they are used*

*Gas stoves leak even while they are off*

*What else is this  
besides methane?*



# Findings

---

# Finding #1: Natural gas used in California homes contains harmful compounds.

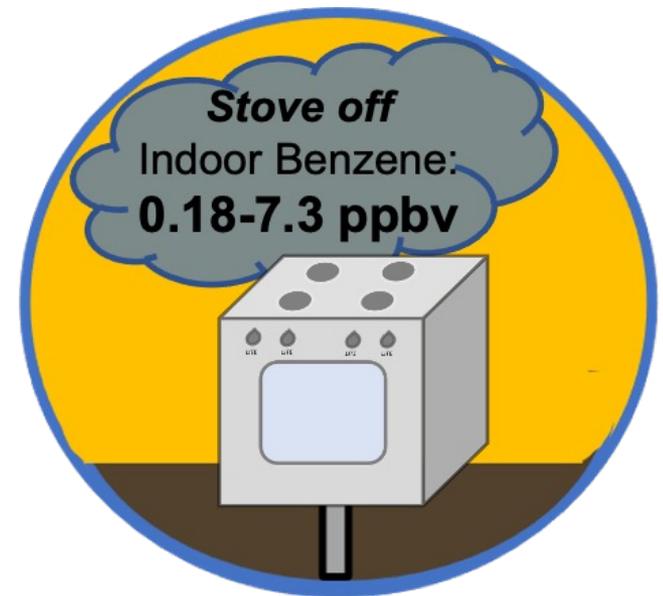
All 159 homes in California contained hazardous air pollutants, most notably benzene, toluene, xylenes, and hexane.

- We detected **12 different hazardous air pollutants** in total.
- We detected benzene – a known human carcinogen - in 99% of samples.

## Finding #2: Natural gas leaks degrade indoor air quality.

**Just having a gas stove in your kitchen can create benzene concentrations comparable to secondhand smoke.**

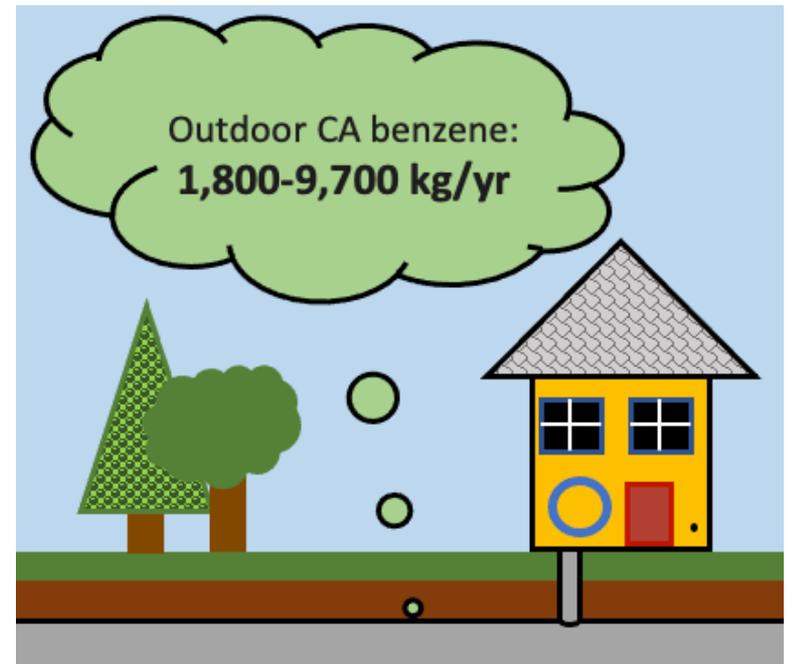
- In California, leaky stoves can exceed California's health exposure guidelines indoors up to **7x**



## Finding #3: Natural gas leaks degrade outdoor air quality.

**Leaks from gas appliances and the pipes that feed them emit the same amount of benzene each year as nearly 60,000 cars.**

- Many inventories do not consider VOCs emitted in household and pipeline gas leaks, which means these are unaccounted-for sources of outdoor air pollution.
- We found that gas contains numerous smog-forming gases like ethane, hexane, toluene, ethylbenzene, xylenes, cyclohexane, etc.

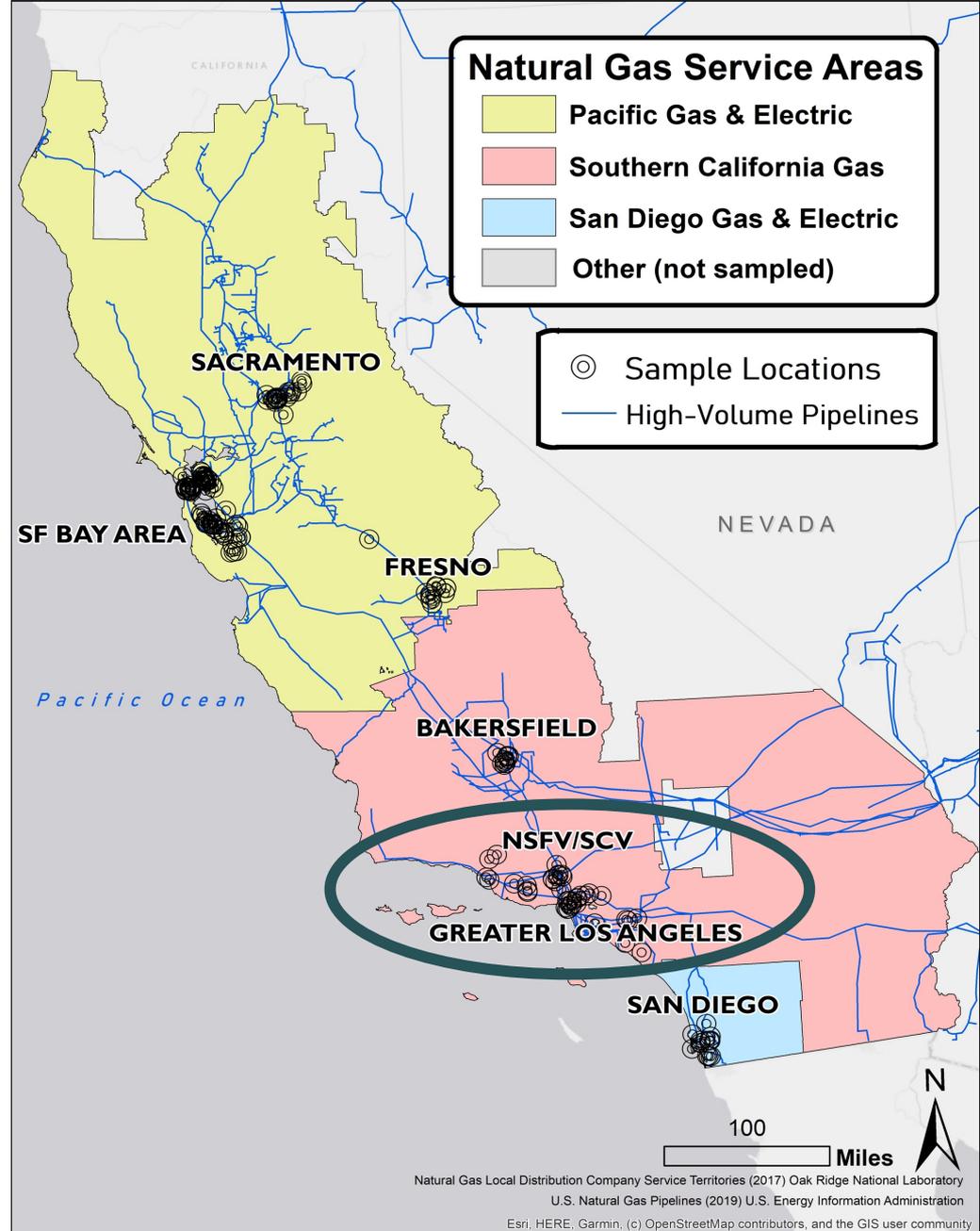


# Findings in Detail

---

# We measured HAPs in natural gas across the state

- 3 different gas companies
- 7 different regions
- 159 total households
- 76 unique chemicals sampled



Ventilation

Stove  
Leak

MODEL

Benzene  
Concentration

Benzene  
in Gas

Kitchen Size



# Natural Gas Leaks and Health

- ***Health risk requires exposure to a hazard***
  - Compared the results to California Reference Exposure Level (REL)
  - California REL is the level at which no adverse health effects are anticipated
  - Exceeding the REL does not automatically indicate an adverse health effect
  - RELs are designed to protect the most sensitive populations
  
- ***Implications for Health***
  - First time showing that indoor leaks alone can exceed health-based guidelines
  - Outdoor gas leaks can form other harmful pollutants like ozone and PM

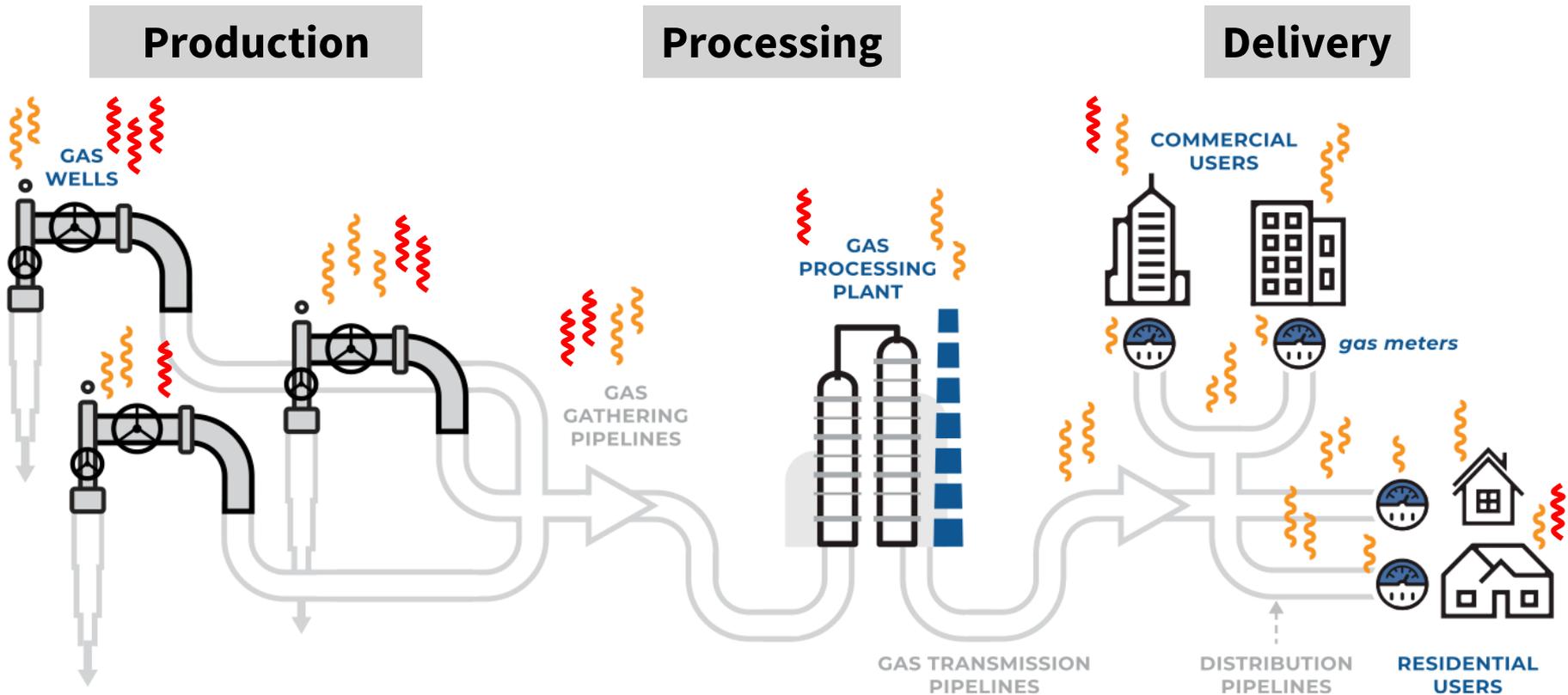
# Conclusions & Implications

---

What does our study mean for health, climate, and policy?

# Gas leaks are an unavoidable part of the system

 Methane  Hazardous Air Pollutants



- Our work builds on the body of evidence that suggests that hazardous air pollutants are co-emitted with methane throughout the gas supply chain.

# Conclusions & Implications

## 1. Gas leaks are unaccounted-for source of air pollution.

- Anywhere natural gas is leaked hazardous air pollutants are leaked.
- If fossil methane leaks are reduced, hazardous air pollutants will be reduced as well.

## 2. Gas leaks impact both indoor and outdoor air quality.

- Individuals, policies, or programs that replace gas appliances with cleaner options can improve indoor air quality.
- Future air quality policies should consider smog-forming compounds from appliance-, city-, and state-level natural gas leaks.

## 3. Gas appliances and systems impact public health and climate.

- Our study shows that policies that phase out gas appliances to protect climate likely have public health co-benefits.
- Reducing fossil gas system leaks or moving away from gas at a system level can protect our climate and public health.

# Thank you!

**Title of Study: Composition, Emissions, and Air Quality Impacts of Hazardous Air Pollutants in Unburned Natural Gas from Residential Stoves in California**

**DOI:** <https://doi.org/10.1021/acs.est.2c02581>

**Contact:** Adrienne Underwood: [adrienne@psehealthyenergy.org](mailto:adrienne@psehealthyenergy.org)

**Acknowledgments:** This work was supported by a grant from the Energy Foundation

**Authors:** Eric D. Lebel, Drew R. Michanowicz, Kelsey R. Bilsback, Lee Ann L. Hill, Jackson S.W. Goldman, Jeremy K. Domen, Jessie M. Jaeger, Angélica Ruiz, Seth B.C. Shonkoff



[www.psehealthyenergy.org](http://www.psehealthyenergy.org)

 [Facebook.com/PSEHealthyEnergy](https://www.facebook.com/PSEHealthyEnergy)

 [@PhySciEng](https://twitter.com/PhySciEng)

 [www.linkedin.com/company/psehealthyenergy/](https://www.linkedin.com/company/psehealthyenergy/)